Notes on the Life Cycle and Natural History of Butterflies of El Salvador. V.A. *Pyrrhogyra hypsenor* (Nymphalidae-Catonephelinae)

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Abstract: For a period of three years eggs, larvae and pupae of *Pyrrhogyra hypsenor* Godman & Salvin have been collected, reared, observed, and photographed in El Salvador. In this paper the results of the observations are published for the first time, placing emphasis on the morphological and behavioral similarities existent with other Catonephelinae and at least with some Callicorinae. Record is made of the larval food plants of the species in Central America. The strong probability that the species is protected against predators is inferred from the conspicuous coloration of the larvae and adults and from the known poisonous properties of the food plants. Finally it is noted that apparently there is a preference for parasitizing Diptera and Hymenoptera to deposit their eggs on the larvae of species protected against predators by the unpalatable and/or poisonous substances sequestered from their food plants, probably to ensure the safety of their own eggs and larvae.

INTRODUCTION

This is the fifth article of a series revealing our observations on the early stages, behavior, and food plants of local butterflies belonging to the Catonephelinae, group of the Nymphalidae. The series will include at least some of the Callicorinae to emphasize the close relation between the two groups, as evidenced by the many morphological and behavioral similarities existent in their respective early stages. This at the same time will establish the great differences that exist with other groups of the Nymphalidae, so as to make one wonder if the common characteristic of the adults having only two pairs of ambulatory legs is a criterion strong enough on which to base a family. Not long ago Papilionidae and Pieridae were grouped together on the basis of the two groups having three pairs of ambulatory legs.

We had observed and collected adults of *Pyrrhogyra hypsenor* Godman & Salvin, since 1958, in ravines and creeks running through coffee plantations in the neighborhood of San Salvador (600 to 900 m altitude), but owing to our deficient knowledge of butterfles, we had always placed them among the

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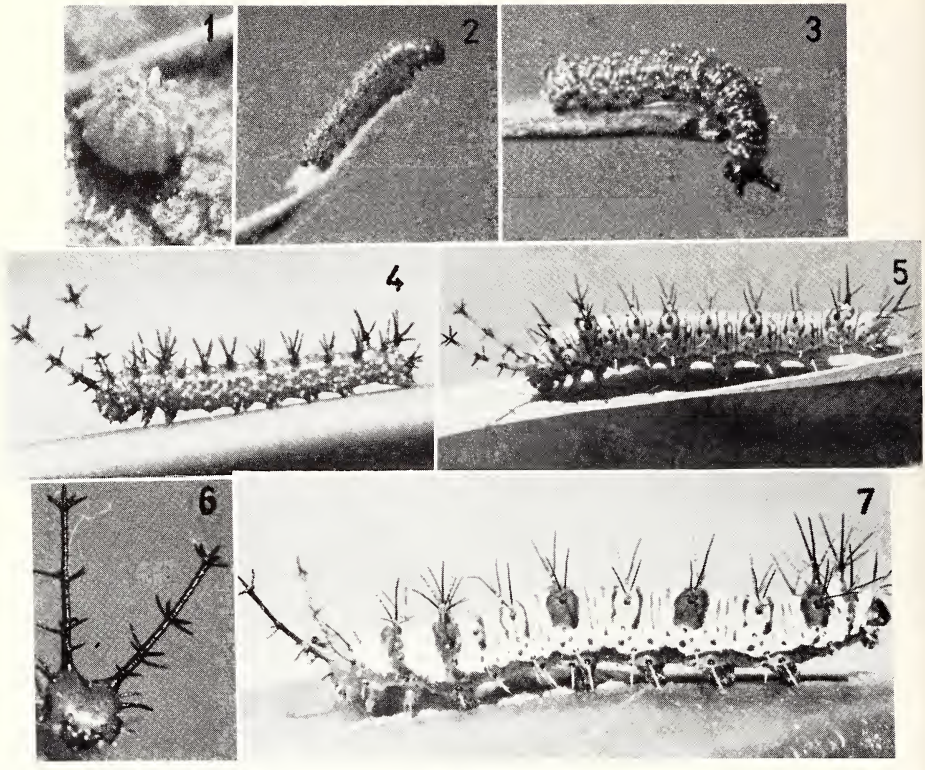
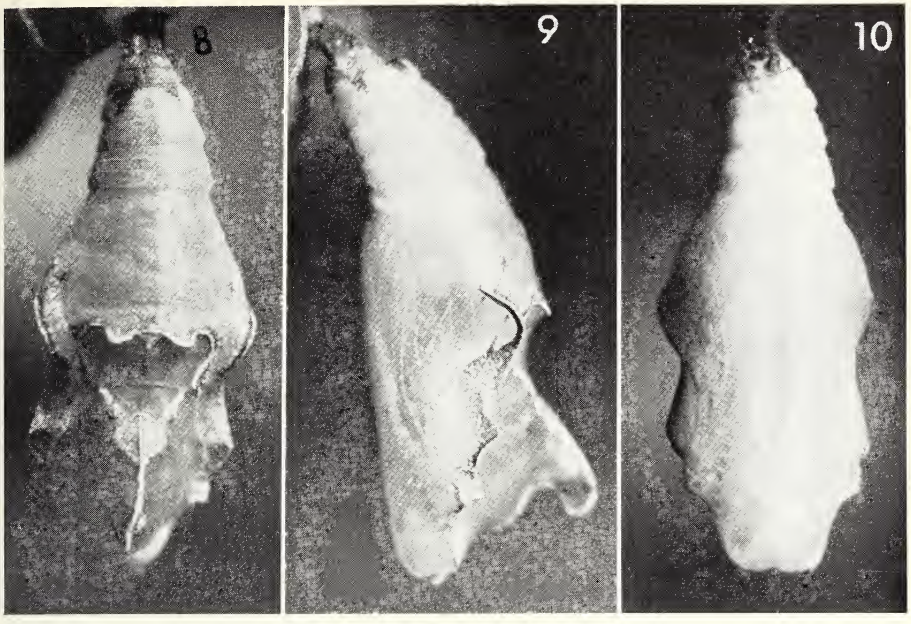


FIGS. 1 to 7. *Pyrrhogyra hypsenor* Godman & Salvin

1. Egg showing prominent ribs. About 1 mm.
2. First instar larva. About 2 mm.
3. Second instar larva. About 3.8 mm.
4. Third instar larva. About 7.5 mm.
5. Fourth instar larva. About 1.6 cm.
6. Close up of head of a fifth instar larva.
7. Fifth instar larva. About 3 cm.

local *Adelpha* species, which they somewhat resemble, and with which they share the habitat. It was not until late 1970, when we were searching a *Paullinia pinnata* L. vine for eggs and larvae of *Morpho polyphemus polyphemus* Doubleday and Hewitson, that we found one larva, which unmistakably pertained to a Catonephelinae and which eventually produced our "pseudo-Adelpha," that we realized our error. The butterfly was identified by S. Steinhauser.

Once the food plant was known, it was a matter of only a few weeks to find a female in oviposition. A number of eggs were collected and put in clear plastic bags. The larvae hatched from them were fed until pupation on leaves of the same plant. Photos were made of the eggs, the different larval instars, and



Figs. 8 to 10. *Pyrrhogyra hypsenor* Godman & Salvin

8. Pupa dorsal view. About 2 cm. long.
9. Pupa lateral view.
10. Pupa ventral view.

the pupae. Measures of the different stages and the time spent in each one were recorded. The bags were kept at all times under ambient conditions of light and temperature. Specimens of the early stages were preserved in alcohol and sent to the American Museum of Natural History, New York, with specimens of the adults.

This is one of the species reared the most, with similar results every time.

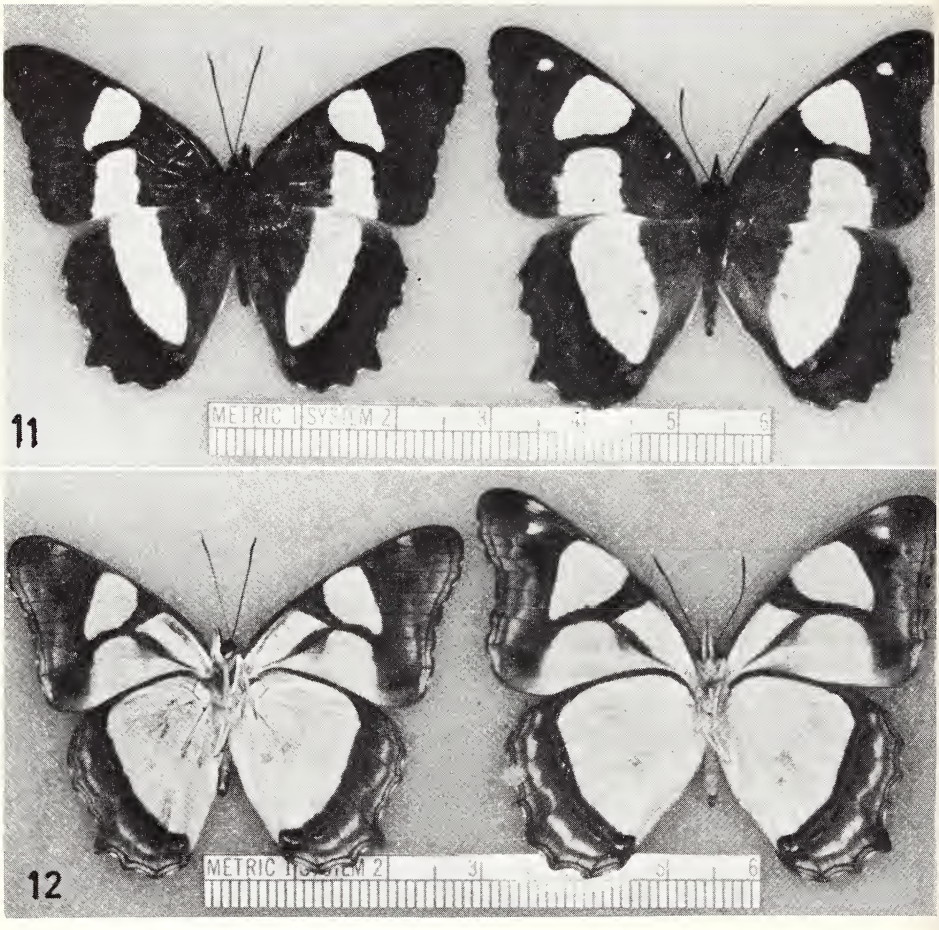
LIFE CYCLE STAGES

Egg. Bright light yellow, truncated-cone-shaped, with 11 prominent yellow ribs from micropylar zone to base. About 1 mm long. Hatches in 5 days.

First instar larva. Head naked, roundish, light brown. Body greenish-yellow, cylindrical, naked, with light brown legs. About 1.5 mm when recently hatched, growing to 2.2 mm before moulting in 4–5 days.

Second instar larva. Head brown with short thick horns on epicrania. Body greenish-brown, with scattered whitish tubercules and small forked spines, growing to 3.5 or 4 mm in 5 days.

Third instar larva. Head cordiform, light brown, with dark brown, long horns on epicrania, bearing three rosettes of accessory spines, and slender spines on lateral margins. Body light brown, except for orange caudal segments, with whitish tubercules and black



FIGS. 11 and 12. *Pyrrhogyra hypsenor* Godman & Salvin

11. Dorsal view of male and female adults.
12. Ventral view of male and female adults.

spines arranged as follows when seen laterally: on first thoracic segment (T–1), 2 subdorsal simple spines, 1 subspiracular simple spine. On T–2, 1 prominent forked subdorsal spine, 1 supraspiracular forked spine, 1 subspiracular simple spine. On T–3, 1 very prominent forked subdorsal spine, 1 forked supraspiracular spine, 1 subspiracular simple spine. On the first abdominal segment (A–1), 1 subdorsal simple spine, 1 supraspiracular simple spine, and 1 subspiracular simple spine. From A–2 to A–6, 1 subdorsal forked spine, 1 supraspiracular simple spine, 1 subspiracular simple spine, and 1 supraventral simple spine. On A–7 and A–8, 1 prominent forked spine at meson in addition. On A–9, 1 supraspiracular forked spine only, directed posterad. The larva grows to .75 cm in 4–5 days.

Fourth instar larva. Head as in third instar but reddish with black horns and spines. Body's ground color brownish-orange with rings of yellow spots mostly dorsally, with black

dorsal stripes across T–3, A–3, A–5, and A–7. Subdorsal spines on T–3, and median spines on A–7 and A–8 very prominent, the latter orange-colored. Spines on A–9 orange with black forks. Growing to 1.6 cm in 4–5 days.

Fifth instar larva. Head as in fourth instar, with longer horns. Body brownish-orange ventrally, mostly yellow above, with thin black rings across segments and red wide bands across T–2 and T–3 from base to base of subdorsal spines. Broad saddle-like zones on dorsum of A–3, A–5, and A–7. Growing to 3 cm in 4–5 days.

Prepupa. All colors but black turn into green. Shortens and thickens considerably. One day.

Pupa. All green except for dark brown cremaster and last abdominal segments. Body thickens gradually to first abdominal segments which are the thickest part of the body dorsoventrally and laterally. A projecting spur directed anterad on the dorsal part of the thorax. Head slightly bifid. Spiracula very inconspicuous brown. Measures 1.5 to 2 cm long, and lasts 7 days.

Adults. This species does not show a marked sexual dimorphism. Wingshape the same in both sexes. Front wing with costal margin slightly convex with rounded apex, slightly concave and sinuose outer margin, rounded tornus and almost straight inner margin. Hindwing with convex costal margin, rounded outer angle, sinuose outer margin, with a more pronounced curve projecting on M3 vein, forming almost a "tail," rounded anal angle and convex inner margin, with a slight fold. Dominant dorsal color dark brown, darker in males. Forewing with two squarish white bands aligned from midcostal margin to mid-inner margin. Females with, in addition, a small round white spot subapically. Hindwing with an elongated white stripe, continuing the white bands of the forewing, starting from midcostal margin, ending in a point before reaching the anal angle. Both sexes with a small red spot between the point of the white stripe and the anal angle.

Dominant color ventrally, white. Forewing with a light brown band covering the distal portion of the wing from ⅔ costal margin to ¾ inner margin, covering the apex, outer margin, and tornus. A thinner brown branch arising from the brown zone, about the discal area, reaching the costal margin at a 60° angle. A secondary brown branch originating from the primary ending at the base of the wing. Basal third portion of the costal margin and all around the white island formed by primary branch, thinly lined with red. Hindwing mostly white with a brown zone alongside the outer margin, covering about ⅓ of the wing surface. On this brown area, alternately light and dark brown thin lines running parallel to the sinuose outer margin, with a row of dark brown spots alongside the basal limit. A thin red line running along the costal margin of the white area continuing along the basal limit of the brown zone.

Average size of adults about 5 cm from tip to tip of spread front wings. Total developmental time varying from 34 to 38 days.

NATURAL HISTORY

In El Salvador the eggs of *Pyrrhogyra hypsenor* are found exclusively on the tender shoots of at least two species of *Paullinia*, either on the new leaves or on the tendrils, and even if only one egg is deposited per location, several eggs per shoot are laid by a single female. As many as 15 eggs have been found on a single tender stem, probably resulting from several females visiting the same terminal.

The recently hatched larvae eat the upper surface of the eggshell and part of the adjacent wall also. They move afterward to the edge or to the tip of a tender leaf and feed thereon, using small pellets of excrement woven with silk to construct a resting perch that protudes from the leaf. The larvae quit this station only to feed, which they do early in the morning or late in the afternoon. While resting, the larvae usually have the head pointing outward, at times holding onto the perch with their prolegs and lifting the anterior part of the body. Second and at times third instar larvae behave similarly. From the third instar on, the larvae roam about the plant but always on the younger leaves on which they feed exclusively, even during later instars.

When the larvae are ready to pupate they move to older parts of the plant or even to neighboring shrubs, choose a place of their liking, weave a silk pad, clean their digestive tract, and affix their anal prolegs to it. Very often the chosen location is the upper surface of a leaf, and the larvae do not hang but lie parallel to the surface.

The pupae, usually found standing at an angle on top of a mature leaf, react when disturbed by wiggling vigorously from side to side, producing an audible squeaking sound. Shortly before adult emergence, the pupae become dark brown.

The adults rapidly abandon the shell and hang from a suitable place, while ejecting a reddish meconium, until the wings are rigid. The process takes about 15 minutes.

Pyrrhogyra hypsenor adults do not visit flowers but feed greedily on a variety of fallen and fermenting fruits, on juices flowing from tree wounds, on excrements and mud. After their long feeding sessions the adults fly to a nearby shrub and sit on top of a well-exposed leaf where they stay motionless except for occasional flappings of the wings, which might be held open most of the time. The adults of this species imitate not only the general color pattern of local *Adelpha spp.* but even their peculiar jerky and sliding flight. We have observed females of *P. hypsenor* alight repeatedly on leaves of a plant commonly used by at least two species of *Adelpha* for oviposition and act as if depositing eggs on it. Although we have observed the species for a number of years, we have never been able to witness copulations.

The tender shoots of the food plants of *P. hypsenor* are currently invaded by a species of aphid, which are tended by ants. The young parts of the plants are also used as food by several species of Theclinae (*T. marsyas*, *T. mykon*, and others).

The larvae and pupae of *P. hypsenor* quite often bring forth tachinid and chalcidid parasites. The tachinidae that were sent to the U.S. Department of Agriculture were determined by C. W. Sabrowski as "*genus sp.*?" [sic], the chalcidoidea were determined by B. D. Burks of the same institution as *Sphilochalcis persimilis* Ashmead. (Both parasites occur also in *Pseudonica flavilla*

canthara Doubleday.) We found, once only, a Pentatomidae nymph (determined by J. L. Herring, USDA, as "*genus sp.* ?") with a third instar larva of *P. hypsenor* impaled on its beak. A frequent cause of larval mortality, both in our insectarium and in the fields, is a disease that produces diarrhea, which is followed by softening of body tissues and death by bursting. Very often we find dead larvae in the fields hanging limp from a leaf, still holding on with their prolegs.

The food plants on which we have found eggs and larvae of *P. hypsenor* belong to the genus *Paullinia* (Sapindaceae); *P. pinnata* L. is by far the most usual, and *P. fuscescens* H.B.K. less usual. On both plants only the tender shoots are used for ovipositioning and feeding by this species.

Paullinia pinnata is a robust, semiscandent, tendril-bearing plant, with alternate, persistent, pinnate leaves consisting of 5 to 7 large (up to 10 cm long) lanceolate remotely dentate, slightly coriaceous leaflets on a broadly winged rachis. The inflorescence is an axilar raceme of small, whitish, 4-petaled flowers, which produce 3-celled, septicidal, roughly pyriform, thick-walled capsular fruits about the size of a coffeebean that are green when young, becoming reddish-orange when mature and containing up to three shiny-black seeds, covered basally by a white arillum. This plant is widely used in the Neotropics for stupefying fish in streams and lakes, and, according to several authors (H. Baillon, 1874; L. Beille, 1909; P. Standley, 1923), it is reputed to be very poisonous and to contain an alkaloid, timboine. Standley says: "Some of the Indians are said to have used the juice to poison their arrows and it is reported that in the Antilles the Negroes have made use of the seeds for criminal poisonings."

P. pinnata and *P. fuscescens*, the alternate food plant, are very widely distributed in the country along wooded ravines and creeks from near sea level to about 1500 m altitude.

DISCUSSION

Seitz (1914) states that very little is known about the larvae of *Pyrrhogyra hypsenor* and although he does not describe the pupa in his work, he states that "The pupa shows the same peculiar attachment as that of *Myscelia*, because it is attached to the upper surface of the leaf." We are not aware of any other publication describing the early stages of the species, so it appears that this is the first mention of them.

Although this species is evidently in close relation to *Myscelia* and thence to the rest of the Catonephelinae, as grouped by Ebert (1969), we feel that it is a link between that group and the Callicorinae, a very closely related group, if we are to judge by the many similarities existent between the early stages and their behavior; the shape of the eggs of this species is more like the shape of the eggs of the latter group than the shape of the eggs of the Catonephelinae,

which are crowned by a series of protuberances around the micropylar area. It is also the only case we have found among the Catonephelinae with eggs colored other than white (the eggs of the Callicorinae are light green). As for the shape and behavior of the larvae and pupae, these conform to the general shape and behavior of the Catonephelinae we have studied.

It is true that the morphological and behavioral characteristics of the Callicorinae show abundant similarities to the other group, but in general the larvae of the Callicorinae are not armed with the profusion of spines peculiar to the Catonephelinae, so that it is an easy task to tell them apart under a superficial examination from the third stadium on.

A factor which is exclusive to this species and seems to indicate an evolutionary trend that may eventually lead the species to adopt a gregarious behavior is the discriminatory use of the young sprouts of the plant only for egg laying and larval feeding. This trait causes a concentration of eggs and larvae, not necessarily originating from one female only, but still usually several from one female, which are forced to live and grow within a limited space. As a result, larval encounters are common events. These do not result in larval fights nor in larval mortality that would be caused by wounds inflicted on each other by contenders. This peaceful coexistence is a total deviation from the individualistic behavior displayed by the rest of the Catonephelinae we have studied, whose larvae fight intransigently against other roaming larvae that accidentally come in contact with them. The larvae of *P. hypsenor* have learned also to accept impassively the continuous traffic of ants tending the aphids which often dwell in their domains, and the occasional disturbances caused by neighboring larvae of Theclinae which share their food.

The preference acquired by this species of feeding on young leaves might be an indication that the young leaves of the *Paullinia* vines are chemically quite different from the older ones, as is the case on *Prunus*, *Kalmia*, *Laurus*, *Quercus*, etc., whose young foliage is much more toxic than the older (Klots, personal communication). If this is the case the larvae feeding on young leaves of *Paullinia* would thus build up rapidly an effective predator-deterrent concentration of toxins.

For the rest, the behavior of the larvae of *P. hypsenor* is exactly like that of the larvae of the other Catonephelinae we have observed: The eggshell is disposed of in the same manner, the larvae build a similar resting perch with frass pellets, they feed at about the same times, and, in the later instars, they crawl about the upper surfaces of the leaves. The pupae stand on the leaves like those of the other species. So they use the cryptical strategy during the early larval stadia, and flaunt their presence in the late instars, even more than the others, on account of their showier colors. This seems to indicate that the protection they might derive from the noxious constituents sequestered from the food plants takes some time to reach the necessary concentration to protect

them effectively against predation. The adult behavior and coloration of *P. hypsenor* tends to support our speculation in this respect: They are the most conspicuous of all Catonephelinae.

In this species we again find that the alleged protection against predation derived from the poisonous properties of the food plant does not protect the larvae against parasitism. In fact the resultant immunity may be an advantage to the parasitic Diptera and Hymenoptera, whose larvae logically would benefit from the repellent properties of the host. The same phenomenon has been noticed in other species of butterflies classically accepted as protected against predation as a result of the food plant having poisonous and/or bitter components. Among these we count several local Danaidae (*D. plexippus, D. eresimus, D. gilippus*), Heliconiidae (*H. charitonius, H. petiveranus, H. talchinia, Eueides aliphera, E. cleobaea*), Ithomiidae (*Dircenna klugii*), Papilionidae (*Battus polydamas, Parides photinus, P. arcas*), feeding on Asclepiadaceae, Passifloraceae, Solanaceae, and Aristolochiaceae, respectively, plants known or reputed to contain noxious substances, and other species feeding on Sapindaceae, such as *Morpho polyphemus* (Young and Muyshondt, 1972), *Temenis laothoe liberia* (Muyshondt, 1973*a*), *Pseudonica flavilla canthara* (Muyshondt, 1973*b*); others on Piperaceae such as *Anaea* (*Consul*) *fabius* (Muyshondt, 1973*c*) and *Anaea* (*C.*) *electra* (Muyshondt, in prep.). All of these species produce, very often during the late larval instar or during pupation, quite a variety of Tachinidae or Hymenoptera parasites.

It is evident that the characteristic of most of the predation-protected larvae of crawling about exposed, displaying their gaudy colors, makes them an easy target for the parasitizing female. That could very well be nature's way of keeping in check the population of a species chemically protected against predation. Perhaps, after more evidence is gathered, it could be deduced that whenever a species is found to be very prone to parasitism, it is to be suspected that that species is chemically protected against predation by food-plant derivatives.

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